Estimating Fractional Sky Cover from Spectral Measurements

Contributors
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Research Highlight

Clouds remain the greatest sources of uncertainty in global climate change research. Monitoring cloud amount has a long history: from earlier human-empirical sky observations, to surface passive and active measurements, to recent satellite retrievals. Satellite observations provide the global coverage of cloud amount to study global climate change. Their limits in spatial/temporal resolution and issues with surface influences manifest the need for surface measurements to verify satellite retrievals and to fill the gaps between satellite observations. Current technology has advanced in surface observations of cloud amounts from human-empirical sky observations, to spatial estimation from sky imagers, to temporal estimation of cloud occurrences from passive and active sensors. However, even with an increasing number of sky imagers and other passive and active sensors for monitoring cloud fraction, there are still limited surface measurements available to date.

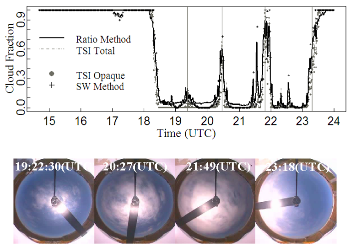
A method has been developed for estimating fractional sky cover from multi-frequency rotating shadowband radiometer (MFRSR) spectral measurements. The spectral characteristics of clouds and clear-sky aerosols are utilized to partition sky fraction. As illustrated in our sensitivity study and demonstrated in real measurements, the transmittance ratio at selected wavelengths is insensitive to solar zenith angle and major atmospheric gaseous absorption. With a localized baseline procedure, retrievals of this ratio method are independent of absolute calibration and weakly sensitive to changes in cloud and aerosol optical properties. Therefore, this method substantially reduces the retrieval uncertainty. The uncertainty of this method, estimated through the sensitivity study and intercomparison, is less than 10%. With globally deployed narrowband radiometers, this simple ratio method can enhance substantially the current capability for monitoring fractional sky cover.

With globally deployed MFRSR-type narrowband radiometers, our simple ratio method can substantially enhance the current capability for monitoring fractional sky cover. Thus, with the use of this method, the amount of surface-based retrievals to verify satellite retrievals and to fill the gaps between satellite observations can be increased significantly.

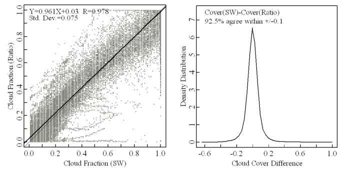
Reference(s)

Min Q, T Wang, CN Long, and M Duan. 2008. "Estimating fractional sky cover from spectral measurements." Journal of Geophysical Research – Atmospheres, 113, D20208, doi:10.1029/2008JD010278.

Working Group(s)
Radiative Processes



Retrieved and observed cloud fractions and corresponding TSI cloud imagers on 8 July 2005 at Pt. Reyes.



Scatterplot of retrieved cloud fraction from spectral ratio method and SW method, and cloud fraction difference distribution for the entire Pt. Reyes field campaign.